RECORDING AND REPRODUCING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a recording and reproducing apparatus, particularly to the recording and reproducing apparatus which records and reproduces encoded digital image data on and from a tape-shaped recording medium.

Related Background Art

A digital VCR which encodes the image data to record and reproduce the encoded image data on and from magnetic tape has been known. In recent years, an apparatus in which the image data is encoded by using inter-frame coding format such as a MPEG system to be record and reproduce on and from the magnetic tape is also known.

One of such kinds of the apparatuses is described in Japanese Patent Application Laid-Open No. H09-214889 (corresponding to U.S. Patent No. 6,292,621).

In the MPEG system, since difference between frames of the image data is encoded, the encoded data can not be decoded using only this difference data, and the image data of a reference frame is required for the decoding.

Since the amount of data of each frame is

varied in the image data which is encoded in the MPEG system, a position where the data of each frame is recorded is not fixed on the magnetic tape. In the case where the image data which is encoded in the MPEG system and recorded is reproduced at high speed, since a track on the magnetic tape can not be correctly scanned with a magnetic head, all the pieces of the data recorded on the tape are not reproduced and the data is discretely reproduced.

Therefore, a possibility of obtaining both the difference data to which the inter-frame coding is performed and the data of the reference frame is extremely decreased, and only the image data of the frame to which the intra-frame coding is performed can be decoded in the high-speed reproduction, so that obtaining the good reproduced image becomes difficult.

In Japanese Patent Application Laid-Open No. H09-214889, it is considered that the good reproduced image is obtained even in the high-speed reproduction in such a manner that image data for high-speed reproduction is generated aside from the normal coding image data by using only the image data to which the inter-frame coding is performed and the image data for high-speed reproduction is recorded at the position which is scanned with the head on each track in the high-speed reproduction.

In Japanese Patent Application Laid-Open No. 2001-309306 (corresponding to US Patent Publication No. 2002003948), there is described a technique, in which the image data recorded using the MPEG system is reproduced and the image data is output in a form of encoded data.

However, Japanese Patent Application Laid-Open No. 2001-309306 discloses a configuration in which the data of a PES format of MPEG2 reproduced from the tape is converted into a TS format to output the data in the form of digital data, but does not consider processing for the case in which the image data for high-speed reproduction is recorded on the tape at all, while Japanese Patent Application Laid-Open No. H09-214889 consider such the processing.

Therefore, in the case where so-called digital dubbing in which the output data is received to be record on the tape as disclosed in Japanese Patent Application Laid-Open No. 2001-309306 is considered, in the apparatus on the recording side it is required to newly generate the image data for high-speed reproduction from the input data of the TS format to be recorded, so that efficiency is not good.

SUMMARY OF THE INVENTION

It is an object of the invention to solve the above-described problems.

It is another object of the invention to be able to transmit and receive the moving image data for normal reproduction and the image data for high-speed reproduction while the moving image data for normal reproduction and the image data for high-speed reproduction are easily encoded.

In order to achieve the above objects, according to an aspect of the present invention, a reproducing apparatus of the invention comprises reproducing means for reproducing moving image data for normal reproduction and image data for high-speed reproduction from a recording medium which records thereon moving image data train including the moving image data for normal reproduction which is encoded by using intra-frame coding and inter-frame coding, and the encoded image data for high-speed reproduction, and an interface which multiplexes and outputs in a form of encoded data the moving image data for normal reproduction and the image data for high-speed reproduction, each of which is reproduced by the reproducing means.

Other objects and features of the invention will become more apparent from the following detailed description of a preferred embodiment of the invention taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing a configuration of a recording and reproducing apparatus to which the invention is applied;

Figs. 2A and 2B show an elementary stream (ES) and a packetized elementary stream (PES);

Fig. 3 shows data which is recorded on tape;

Fig. 4 shows the packetized elementary stream (PES) and a transport stream (TS);

Fig. 5 shows TS data; and

Fig. 6 shows a state of the configuration in dubbing operation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of the invention will be described below referring to the accompanying drawings.

Fig. 1 shows the configuration of a recording and reproducing apparatus 100 to which the invention is applied. As described above, while the recording and reproducing apparatus 100 of Fig. 1 encodes the image data and the audio data pursuant to the MPEG system, the recording and reproducing apparatus 100 generates the image data for high-speed reproduction, to record and reproduce the data on and from a plurality of tracks on the tape.

At first, normal recording processing will be

described.

The moving image signal and the audio signal, which are input from an input unit 101, are output to encoders 102 and 105 respectively. The encoder 102 encodes the input moving image signal pursuant to the MPEG2 format and outputs the encoded data to a search data generation unit 103 and a packetization unit 104. The data output from the encoder 102 is referred to as a video elementary stream (ES).

The packetization unit 104 divides the video ES data output from the encoder 102 into a plurality of blocks on predetermined data amount basis and forms a plurality of packets by adding a predetermined header to each block. The packet is referred to as a packetized elementary stream (PES) packet, and the data output from the packetization unit 104 is referred to as a video PES. Fig. 2A shows the video ES and the video PES packet. The packetization unit 104 generates the video PES from the video ES to output the video PES to a multiplexing unit 107.

In the MPEG2 format, the image data is encoded by switching among the intra-frame coding, forward predictive coding, and bidirectionally predictive coding on each frame basis. The search data generation unit 103 generates the image data for high-speed reproduction by using only the image data of the frame (I frame) to which the intra-frame

coding is performed, among in the video ES output from the encoder 102, and the search data generation unit 103 outputs the generated data to the multiplexing unit 107.

The encoder 105 encodes the input audio signal pursuant to the MPEG audio coding system and outputs the encoded data to a packetization unit 106. The data output from the encoder 105 is referred to as an audio elementary stream (ES).

Similarly to the packetization unit 104, the packetization unit 106 divides the audio ES data output from the encoder 105 into the plurality of blocks on predetermined data amount basis and forms the plurality of packets by adding the predetermined header to each block. The data output from the packetization unit 106 is referred to as an audio PES. Fig. 2B shows the audio ES and the audio PES. The packetization unit 106 generates the audio PES from the audio ES to output the audio PES to a multiplexing unit 107.

According to a direction from a control unit 116, the multiplexing unit 107 divides the image data for high-speed reproduction into the plurality of blocks on predetermined data amount basis and adds the predetermined header to each block. The video PES output from the packetization unit 104, the audio PES output from the packetization unit 106, and the

image data for high-speed reproduction output from the search data generation unit 103 are multiplexed to be output to a recording and reproduction unit 108 so that the block of the image data for high-speed reproduction is recorded at a position, where the tape is scanned with the head during the high-speed reproduction, in each track on tape T.

Fig. 3 shows the data output from the multiplexing unit 107.

The recording and reproduction unit 108 forms the plurality of tracks on the tape T to record sequentially the data output from the multiplexing unit 107, by using a rotational head.

Then, the operation in which the data is output from a digital interface during the normal recording will be described.

The video PES output from the packetization unit 104, the audio PES output from the packetization 106, and the image data for high-speed reproduction output from the search data generation unit 103 are also output to a transport stream (TS) processing unit 117.

According to the direction from the control unit 116, the TS processing unit 117 converts the video PES data, the audio PES data, and the image data for high-speed reproduction into the transport stream format of MPEG2 and outputs the converted data

to a digital interface (DIF) 118.

The conversion processing performed by the TS processing unit 117 will be described below.

The TS processing unit 117 divides the video PES data, the audio PES data, and the image data for high-speed reproduction into the plurality of blocks on predetermined data amount basis and generates a 188-byte transport stream (TS) packet by adding the predetermined header (TS header) to each block. The TS processing unit 117 multiplexes the TS packet generated from the video PES, the TS packet generated from the audio PES, and the search data TS packet generated from the image data for high-speed reproduction at predetermined timing to generate TS.

Fig. 4 shows the multiplexing processing which is performed by the TS processing unit 117.

In Fig. 4, a reference numeral 401 denotes the video PES and a reference numeral 402 denotes the audio PES. In transport streams (TS) 403, a reference numeral 403V denotes the TS packet generated from the video PES 401, a reference numeral 403A denotes the TS packet generated from the audio PES 402, and a reference numeral 403S denotes the TS packet of the data for high-speed reproduction.

In TS, a 13-bit packet ID (PID) for identifying the data of each packet is added to a TS packet header. The TS processing unit 117 multiplexes and

outputs at predetermined timing a program map table (PMT) showing contents of a program included in the packet of each PID and a program association table (PAT) for detecting PMT. PAT and PMT are referred to as program specific information (PSI). In particular, number 0 is allocated to PID of the TS packet having PAT.

In the present embodiment, predetermined values are independently allocated to PID of the video TS, PID of the audio TS, and PID of TS of the image data for high-speed reproduction, and PID of each TS packet is described in PMT. This allows the contents of the data to be detected only by detecting PID of each TS packet.

Fig. 5 shows the TS data, the TS packet, and the TS packet header.

DIF 118 outputs the TS data, which is output from the TS processing unit 117, to the outside of the apparatus pursuant to a format specified by an IEEE1394 standard.

The normal reproducing operation will be described below.

When the control unit 116 gives the direction of the normal reproduction, the recording and reproduction unit 108 reproduces the data train of the moving images recorded in the above-described manner from the tape T and outputs the data train of

the moving images to a demultiplexing unit 109. The demultiplexing unit 109 detects the video PES, the audio PES, and the image data for high-speed reproduction from the reproduced data train of moving images, outputs the audio PES to a conversion unit 110, outputs the video PES to a conversion unit 112, and outputs the image data for high-speed reproduction to a decoder 113.

The conversion unit 110 detects each PES packet header from the output audio PES to generate the audio ES and outputs the audio ES to a decoder 111. The decoder 111 decodes the output audio ES to output the decoded audio ES to an output unit 114.

The conversion unit 112 detects each PES packet header from the video PES output from the demultiplexing unit 109 to generate the video ES and outputs the video ES to the decoder 113. In the normal reproducing operation, according to the direction from the control unit 116, the decoder 113 selects the video ES from among the video ES output from the conversion unit 112 and the data for high-speed reproduction output from the demultiplexing unit 109, to decode the video ES to output the decoded video ES to an output unit 114.

The output unit 114 converts the audio data output from the decoder 111 and the audio data output from the decoder 113 into the format suitable for the

external devices and outputs the converted data.

Then, the processing in which DIF 118 outputs the data in the normal reproducing operation will be described.

The demultiplexing unit 109 also outputs the video PES, the audio PES, and the image data for high-speed reproduction, each of which is detected from the data train of images reproduced in the above-described manner, to a TS processing unit 117.

Even in the normal reproducing operation, similarly to the above recording operation, the TS processing unit 117 generates the TS packets from the video PES, the audio PES, and the image data for high-speed reproduction, according to the direction from the control unit 116, and the TS processing unit 117 multiplexes the generated TS packets to generate the TS data. DIF 118 outputs the TS data to the outside of the recording and reproducing apparatus 100.

That is to say, in the present embodiment, the moving image data, the audio data, and the image data for high-speed reproduction, each of which is reproduced from the tape T, are converted into the TS format and output it.

The high-speed reproduction processing will be described below.

When an operation unit 115 directs the high-

speed reproduction, the control unit 116 directs the recording and reproduction unit 108 to reproduce the image data by feeding the tape T at predetermined speed faster than that of the normal reproduction.

The recording and reproduction unit 108 reproduces the image data by feeding the tape T at higher speed. At this point, the image data for high-speed reproduction which is recorded at the position corresponding to a scanning trajectory of the head in the high-speed reproduction in each track on the tape T is reproduced.

The demultiplexing unit 109 detects the image data for high-speed reproduction from the data output from the recording and reproduction unit 108 and outputs the image data for high-speed reproduction to the decoder 113. According to the direction from the control unit 116, the decoder 113 decodes the image data for high-speed reproduction output from the demultiplexing unit 109 and outputs the decoded image data for high-speed reproduction to the output unit 114. The control unit 116 also controls the conversion units 110 and 112 so as not to output the audio PES and the video PES, each of which is output from the demultiplexing unit 109, in the high-speed reproduction.

Then, the dubbing operation will be described, wherein the TS data, which is reproduced by the

external device and output in the above-described manner, is input through DIF 118 to perform the recording.

In this case, as shown in Fig. 6, DIF 118 of the recording and reproducing apparatus 100 shown in Fig. 1 is connected to DIF 118′ of a recording and reproducing apparatus 100′ having the same configuration as the recording and reproducing apparatus 100 with an IEEE 1394 cable 601. The recording and reproducing apparatus 100′ is operated to reproduce image data to generate the TS data as in the above-described manner, and the TS data is output to DIF 118 of the recording and reproducing apparatus 100 through the DIF 118′.

In the recording and reproducing apparatus 100, the data reproduced by the recording and reproducing apparatus 100′ can be recorded on the tape T by instructing to record the data input from DIF 118.

The processing in which the data from DIF 118 is recorded by the recording and reproducing apparatus 100 will be described below.

DIF 118 inputs the TS data output from the recording and reproducing apparatus 100′ to output the TS data to the TS processing unit 117.

According to the direction from the control unit 116, the TS processing unit 117 detects PID of each of TS packets of the video PES, the audio PES,

and the image data for high-speed reproduction on the basis of PAT and PMT in the input TS data, and the TS processing unit 117 detects the TS packet of each data on the basis of the detected PID. Then, the TS processing unit 117 generates the original video PES, the original audio PES, and the original image data for high-speed reproduction from each TS packet to output them to the multiplexing unit 107.

According to the direction from the control unit 116, the multiplexing unit 107 multiplexes the video PES, the audio PES, and the data for high-speed reproduction, each of which is output from the TS processing unit 117, so that the block of the image data for high-speed reproduction is recorded at the position, where the tape is scanned by the head during the high-speed reproduction, in each track on tape T. The multiplexing unit 107 outputs the multiplexed data to the recording and reproduction unit 108.

According to the direction of a recording start from the operation unit 115, the control unit 116 outputs the direction of start of the recording to the recording and reproduction unit 108. According to the direction of the recording start from the control unit 116, the recording and reproduction unit 108 records the data train of images from the multiplexing unit 107 on the tape T.

The processing in which the TS data input from DIF 118 is decoded and output will be described below.

When the control unit 116 gives the direction of the external input reproduction, in the same manner as in the case of the dubbing operation, the TS processing unit 117 detects the video PES, the audio PES, and the image data for high-speed reproduction from the TS data output from DIF 118, outputs the audio PES to the conversion unit 110, and outputs the video PES and the image data for high-speed reproduction to the decoder 113.

According to the direction from the control unit 116, the conversion unit 110 selects the audio PES output from the TS processing unit 117 to generate the audio ES and outputs the audio ES to the decoder 111. The decoder 111 decodes the audio ES output from the conversion unit 110 to output the decoded audio ES to the output unit 114.

According to the direction from the control unit 116, the conversion unit 112 selects the video PES output from the TS processing unit 117 to generate the video ES and outputs the video ES to the decoder 113. The decoder 113 selects the video ES from among the video ES output from the conversion unit 112 and the image data for high-speed reproduction output from the TS processing unit 117, and the decoder 113 decodes the video ES to output

the decoded video ES to the output unit 114.

The output unit 114 outputs the audio data output from the decoder 111 and the image data output from the decoder 113 to the outside of the recording and reproducing apparatus 100.

As described above, according to the embodiment of the invention, the TS processing unit 117 converts the audio PES, the video PES, and the image data for high-speed reproduction, each of which is reproduced from the tape, into the TS data to output them through DIF 118, so that it is not necessary in the apparatus on the recording side that the image data for high-speed reproduction is newly generated even in the digital dubbing operation.

In the above embodiment, although the data for high-speed reproduction is always multiplexed and transmitted when transmitting the image data from DIF, for example it is also possible that the contents of the register managing whether the image data for high-speed reproduction is required or not is previously checked through DIF 118 and the image data for high-speed reproduction is transmitted without multiplexing the image data for high-speed reproduction by the TS processing unit 117 when the data for high-speed reproduction is not required.

Many widely different embodiments of the present invention may be constructed without

departing from the spirit and scope of the present invention. It should be understood that the present invention is not limited to the specific embodiments described in the specification, except as defined in the appended claims.